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Determination of optical constants and nonlinear optical coefficients of Violet 1-doped polyvinyl alcohol thin film

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Abstract. The optical properties of Violet 1-doped polyvinyl alcohol (PVA) have been investigated using Wemble and Didomenico (WD) method. The optical constants such as refractive index n, the dispersion energy E_d, the oscillation energy E_0, the lattice dielectric constant ε_∞, light frequency dielectric constant ε_0 and the ratio of carrier concentration to the effective mass N/m^* have been determined using reflection spectra in the wavelength range 300–900 nm. The single-beam Z-scan technique was used to determine the nonlinear optical properties of Violet 1:polyvinyl-alcohol (PVA) thin film. The experiments were performed using continuous wave (cw) laser with a wavelength of 635 nm. The calculated nonlinear refractive index of the film, $n_2 = -2.79 \times 10^{-7}$ cm^2/W and nonlinear absorption coefficient, $\beta = 6.31 \times 10^{-3}$ cm/W. Optical limiting characteristics of the dye-doped polymer film was studied. The result reveals that Violet 1 can be a promising material for optical limiting applications.

Keywords. Absorption spectra; nonlinear optics; optical constants; optical limiting.

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1. Introduction

Much work has been done since the mid-1980s, towards the study of nonlinear optical (NLO) materials. This topic is still at the forefront of current research because NLO materials form the basis of advanced photonic technologies of the 21st century. Due to the higher dimensionality of the frequency space, the third-order NLO materials offer more varied and richer properties than the second-order NLO materials. They find a wide variety of applications in photonic fields such as optical phase conjugation, dynamic holography, optical limiting, optical switching, etc. Until now, great efforts have been made towards exploring the third-order NLO properties of many materials such as organic materials, inorganic materials, nanomaterials, semiconductors, polymers and so on [1–7]. Among these materials, the organic materials, due to their large optical nonlinearities and